DOCUMENT RESUME

ED 108 162 CS 001 950

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TITLE	Word-Phrase Comprehension as Concept Learning.
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SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	SWRL-TM-1-71-5
PUB DATE	Apr 71
NOTE	14p.
EDRS PRICE	MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS	*Associative Learning; *Concept Formation; Inductive Methods; *Learning Processes; Primary Education; *Reading Comprehension; *Word Recognition

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SWRL

SOUTHWEST REGIONAL LABORATORY
TECHNICAL MEMORANDUM

DATE April 20, 1971

NO TM-1-71-5

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ABSTRACT

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WORD-PHRASE COMPREHENSION AS CONCEPT LEARNING

Bourne (1968) understates the case when he says that "Studies of concept formation . . . seem a potentially valuable source of knowledge about the acquisition of word meaning, particularly denotative meaning . . ." When the word or phrase names a concept, then whether we are talking about research or instruction, acquisition of the meaning of the linguistic unit will be isomorphic with concept formation. This paper, then, will consider word-phrase comprehension instruction as the learning of real-world concepts (and perhaps some that are in other universes of discourse). Such concepts constitute an appreciable subset of the concepts named by those items entering the child's speech lexicon during the primary instructional years.

ORIENTATION TO CONCEPT LEARNING

A primitive concept is characterized by a single attribute or characteristic. As Bourne notes, ". . . any attribute itself will denote a class of things and therefore is a concept . . . Attributes can be thought of as primitive . . . concepts from which more complicated, multiattribute groupings are constructed." Multiattribute concepts are characterized by two or more attributes that are related to each other by one or more relational terms. Relational terms may be those of logic--e.g., conjunction, disjunction--or may be characterized by relations or processes variously characterized in language--e.g., as verbs and prepositions. Some relational terms may even appear as nouns in language--e.g., "Zots are long-fingered, large-bellied, pointed-eared ape-like animals." If ape is in the child's store of interpreted lexical items, then that term relates the other cited anatomical attributes of a zot.

The multiattribute concept reflects a set of attributes and a rule that specifies how these attributes are related to reflect the domain of the concept. If we take the concept as a definiendum, then such a rule might take the form of a definition: Definiendum = definiens. Learning the rule per se does not insure learning its domain.

Concept learning contrasts with concept naming (or renaming) and with concept identification. Concept learning adds to the child's conceptual store; naming (or renaming) and identification do not. Unless one intends to expand the entry domain, then relabelling the child's speeding up as acceleration introduces no new concept. There are occasions when the child will have a concept but no name for it and others when he will have the concept but name it unconventionally. Training him to label or relabel has nothing to do with concept learning.

Concept identification sometimes is paired (perhaps inadvertantly) with concept learning in experimental studies featuring complex tasks.

However, pure concept identification involves detecting a previously-learned concept that a given set of items or item sets exemplarizes. For example, if under appropriate instructions one presents pairs of speedometer readings, one member reflecting reading r_1 at time t_1 and the second a higher reading r_2 at time t_2 and requires college students to respond speeding up, then in light of experience at the college level the task is one of concept identification. No new concept is learned.

One thing that the psychological learning literature typically is not is a key to sound pedegogical practice. Concept learning experiments (and in fact most learning experiments of every kind) typically have detective story structure--the crime is presented but great care is taken to hide the solution (cf, Dulany, 1968). While such an orientation may perhaps be apt to the acquisition of detective skills, much concept acquisition that is necessitated by objectives of primary education can and should be divorced from sleuthing. The instructional requirement for such concept learning instruction is to produce geographers of already-charted waters, rather than explorers of new domains. It is conceivable that discovery learning will prove apt to teaching individuals to chart new waters--whether in the scientific or the social domain. However, discovery learning will prove pedegogically efficient when referenced to non-discovery objectives only if efficiency presumes a high level of reactive inhibition--not highly probable.[1]

For pedegogical purposes at least, the exemplars of a concept cannot be exhausted. In consequence, one probably cannot even approximate concept learning by reducing it to an associative learning task. The alternative--for educators if not scholars--is not to turn to a hypothesis-testing view, with its emphasis on discovery, for that approach burdens the learning of already-charted concepts with more mystery than is warranted. No doubt, hypothesis-testing in some form will occur during an induction process, no matter how extensively and systematically one exemplarizes and "talks to" a concept during training. The educator's goal, when dealing with already-charted concepts, should be one of striking a balance between pedegogical efficiency and hypothesis-testing requirements.

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1 An overdue work is Why Johnny Can't Do This and That as Well as He Could Before the Modern This and That Treatments were Introduced into the Schools. It is possible that the "modern treatments" will beneficially affect scientific and other intellectual output of society in the years ahead, particularly if the gap between their pedegogical intent and the course they actually chart is closed. However, such one-dimensional panaceas as discovery learning, when applied across the board, can only decline efficiency levels to those that existed before New-Fist-Hammer-Maker took the children off the streets.

It need not be the case that the relation between pedegogical efficiency and hypothesis-testing requirements of concept learning is a simple one described by a monotonic inverse function. However, for present purposes such a relation will be assumed. That is, we assume preliminarily that reasonable efforts to reduce hypothesis-testing requirements of word-phrase comprehension instruction will be rewarded by accompanying increments to pedegogical efficiency. This assumption is, of course, falsifiable; in a more-sophisticated form that considers some other factors, the assumption should perhaps be tested in an apt R&D setting.

If the child lacks a concept of interest, then one place to begin is with a name for the concept--e.g., a single word (hut) or a phrase (closed plane figure). While a name N denotes a concept C, in pedegogical practice the point of departure for guided concept learning instruction during the earlier primary years is simply N, a word or phrase whose conceptual domain is to be specified. The term word-phrase comprehension emphasizes this point of departure to concept learning.

THE CONCEPT GROWS BUT THE NAME LINGERS ON

Typical concept learning examples (e.g., Bourne, 1968; Gagne, 1970) entail reaching a concept having several characteristics of interest (a multiattribute concept) through its component single-characteristic (primitive, prerequisite) concepts. A simple example would be to reach the concept salt water through the concepts salt and water. (Such a concept as salt water is sometimes described in terms of the conjoinment of salt things and water things; it is more aptly described as the intersection of the salt thing and water thing sets.)

With children entering school the problem often is somewhat the reverse of that inherent in teaching salt water. Rather, given a constant name that applies to all levels of maturation and of conceptual domain, the educational task is to expand the domain of a concept that the child brings to school in an unacceptably restricted form. Consider plane triangles. Most children come to school with an unduly restricted but otherwise apt notion of what a triangle is. It would not be surprising to find them judging as triangles those representatives of plane triangles: a) whose area falls in the range .5 to 1.5 square inches, b) whose angles do not depart appreciably from equilateral requirements, and c) whose orientation is essentially base-down. That is, preformal instruction treats the concept as much more concrete than instruction in the earlier primary years may require. The instructional task then is to broaden the entry domain of the concept consonant with instructional objectives of the early primary years--e.g., to provide prerequisite skills for treatments of geometry (and square-peg, round-hole testing). This task might be accomplished by progressively deforming the child's idealized restricted view of plane triangularity along size, angularity, and orientation dimensions (but not necessarily in that order).[2]

A concept usage in a sentence or other linguistic construction is a linguistic exemplar of the concept or of the conditions under which it applies. Linguistic exemplars contrast with physical exemplars--representations of the concept in physical space of n-dimensionality. For a plane figure, a 2D representation may prove the epitome of physical representation. (Whether the triangles of Buckminster Fuller's geodesic domes or of the flower beds of a formal rose garden belong to the class of plane triangles is moot. One speculates that these are 2D representations in 3D space.) For other concepts under appropriate conditions of past experience and setting instructions, 2D representation may have pedegogical value even though 3D or 4D representation more faithfully portrays the situation.[3] Physical exemplarization is discussed more fully in the section that follows; linguistic exemplarization in the section after that.

PHYSICAL EXEMPLARIZATION

Consider the definition "A triangle is a closed plane figure bounded by three straight lines." Earlier remarks indicate that this definition specifies an ultimate domain encompassing as exemplars representations of all possible plane triangles. Enroute to this definition, the instructional designer might wish to construct a series of progressively less-constraining statements concerning those exemplars that can be introduced during each of a progression of segments of instruction. An illustrative set of such statements is the following:

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[2] It is of interest that the formal definition of plane triangles has nothing specific to say concerning size, angularity, and orientation of representations that exemplarize the concept. The formal definition reflects an ultimate-domain view of the concept. An instructional design operation is privileged to define a progression of domain sizes that are bounded by entry and ultimate size; such an ordered set will define a corresponding set of enroute performance requirements belonging to a learning hierarchy for the concept.

[3] Concepts like honesty can perhaps be exemplarized in pantomime in 4D situations. For present purposes, if such a concept is handled entirely linguistically, then its exemplarization will be considered a linguistic exemplarization. Such a classification assumes that an exemplarization that makes no contact with physical space-time will be effective only if the language mediation process is effective. It seems tenable that there are conditions under which such a process will be effective and conditions under which it will not (cf, Follettie, 1971).

1. Exemplars sample from the universe of all possible orientations for equilateral triangles whose area is 1 square inch.

2. Exemplars sample from the range .5 to 16 square inches of the area universe for equilateral triangles whose orientation is base-down.

3. Exemplars sample from the range 60-150 degrees of the largest-angle size universe for triangles whose other two angles are of equal size, whose area is 1 square inch, and whose orientation is base-down.

4. Exemplars sample from the range 0-70 degrees of the universe of departures from equal size of the two smallest angles for triangles whose largest angle is 90 degrees, whose area is 1 square inch, and whose orientation is first-quadrant.

5. Exemplars vary jointly in 1 and 2.

6. Exemplars vary jointly in 1, 2, and 3.

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n. Exemplars vary jointly in all factors; exemplars are a sample from the universe of the ultimate domain for plane triangles as this is formally defined.

It seems tenable that we might wish to point out to the child during Segment 1 training that a triangle is a triangle, whatever its orientation, with the concept orientation of triangles verbally characterized and exemplarized by the 2D representations delimited by Statement 1. The verbal characterization of the orientation concept might or might not be a formal definition. Let us agree that any concept or characteristic of a concept can be verbally characterized in pedegogically useful ways--that is, in ways that dispel some of the mystery concerning what is to be learned. The formal definition of a concept or characteristic--itself a concept--is a member of the set of all possible verbal characterizations of the concept. In the case of the foregoing illustrative set of domain statements, the terminal member of an associated set of verbal characterizations is a formal definition for the concept of plane triangles. The other members of the associated set of verbal characterizations cannot be formal definitions of the concept of plane triangles. However, since each domain statement implies its own set of related attributes, then there should be associated with each such statement a set of possible verbal characterizations, one of which is a formal definition.

The foregoing views rest on a heretofore not-enunciated principle of pedegogical strategy for concept learning: There will be interplay between the verbal characterization and its physical exemplarizations.

It ought to be the case that if the physical exemplars used in training serve as context to verbal characterization, then the level of linguistic explication can be less than is implied by a formal definition. That is the effect of physical context on linguistic expression in most universes of discourse; there is no reason for believing that it will not be true here as well.

The illustrative set of ordered domain statements presented above provides intuitive grounds for resisting the notion that the concept of plane triangularity should be treated initially at the ultimate domain level reflected by Statement n. We sometimes hear such a notion confused with the notion that concept learning in the early primary grades should not proceed from a formal definition of the concept. It is not clear at the level of Statement 1 that a formal definition would be so different from any other permissible verbal characterization made in a context of exemplars.

Given that one distinguishes between levels of projected growth for a concept--each level specifying its own concept even though the different concepts share a single name--and that verbal characterizations will be context-bound, then a stricture on the use of formal definitions may prove misguided.[4]

For any concept or conceptual domain, two operations referencing to physical exemplars seem pedegogically entertainable. These are: a) presentation of the set of training exemplars and b) verbal characterization of the domain in the context of the set of training exemplars characterizing the domain.[5] Let E denote the exemplarization of the concept and V the verbal characterization in context E. Three Training

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4 Will it be useful during Segment 3 training to make use of the formal definition that is appropriate to the ultimate domain described by Statement n? This is an empirical question of the advance organizer type. It is possible that definitions characterizing an ultimate or later conceptual domain toward which instruction is heading will facilitate the learning of an earlier concept in the chain.

5 Exemplars are positive instances of a concept. The pedegogy preliminarily assumed reflects use only of positive instances during training. The use of negative instances would complicate training in fully-predictable ways. The relative benefits of using only positive instances under the guided induction conditions envisioned here and of using both positive and negative instances should be evaluated using samples from the concept and learner universes of primary education. The contemplated pedegogy envisions using both positive and negative instances only in selection-form testing situations.

sequences involving E and V may be distinguished.[6] These are:

1. V, then E (successive).

2. E, then V (successive).

3. V in the context E (overlapping).

When the exemplar is in aural form, only the first or second sequence can be used unless V is presented in visual form. When the exemplar is in visual form and 2D or 3D, then all three sequences apply and two or more exemplars can be presented simultaneously. When the exemplar is in visual form and 4D--e.g., a pantomime of honesty--then all sequences apply but exemplars must be presented one at a time. It is assumed, and falsifiable, that each of these three sequences will guide the induction of the communality of exemplars, and so induction of the conceptual domain. Where all sequences apply, an efficient practice routine might mix the sequences or might require that just one of them be used. Such empirical matters remain to resolve.

LINGUISTIC EXEMPLARIZATION

Assume the following prerequisite skills (to usage exemplarization and training):

1. The child is able to decode items of a prerequisite lexicon to semantic meaning. That is, he comprehends the lexicon consonant with instructional intent.

2. Where sentence form exemplars use only items from the prerequisite lexicon, the child is able to decode exemplars from a prerequisite set of sentence forms to linguistic meaning. (If needed, a parallel assumption at the supersentence level would be made.)

Consider a concept C whose usages may be exemplarized using one or more members of a subset of the prerequisite sentence forms. For a

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6 A training approach that features E only would require that the concept, as reflected by the communality of elements of the training set of exemplars, be induced or discovered strictly on the basis of exemplar charactersitics. A training approach that features V only---verbal characterization without the context provided by E--would push discovery back one or more steps; such an approach would require that language-mediated prior experiences serve as the only clues to the conceptual domain. It seems worth entertaining that the positive-negative instances doctrine and research arises from the pedegogical biases of treating concept learning as problem solving and, hence, withholding the guided basis for induction that V affords.

given form F_1, C can occur either at point N_i or N_j. C occurs at one of these points; all other lexical items of F_1 are drawn from the prerequisite lexicon with due provision for form class requirements of F_1. Iterating the routine yields a universe (or large set) of linguistic usage exemplars for F_1 (N_i) and F_1 (N_j). Applying the routine then to other members of the subset of prerequisite sentence forms that can be used to exemplarize the usage of concept C, we obtain large sets of usage exemplars for F_2 (N_i) through F_n (N_m).

If we are interested and if the prerequisite set of sentence forms encompasses the proper transformation rules, we can even go from such usages as "N V triangles" to "N_1 triangularizes N_2." This, of course, is a word formation, or morphology, objective. While triangularization is a related concept to triangularity, triangularization as a 4D process extends the domain of the 2D concept of triangularity. Until the child reaches a point where we impute to him a language mediation skill whose efficiency approaches unity, word formation instruction should not be viewed as merely dealing with linguistic concepts. Although such matters will not be discussed further in this paper, there clearly is a need to relate concept learning in the physical domain more intimately with the learning of linguistic concepts of every sort. Those whose findings support the complaint that formal instruction in grammar in the primary years does little or nothing for the child probably are operating on a too-wistful view concerning what will facilitate language-mediated learning of information falling outside the linguistic universe of discourse.

Exemplarizing the usages of a concept is conventional in contemporary concept learning instruction in the schools. Presumably this is done on the grounds that it aids the language-mediated acquisition of concepts. If that is so when a proper basis for obtaining language mediation effects exists, then instruction featuring linguistic usages of a concept might be viewed as providing a prerequisite skill to the learning of concepts outside the linguistic universe of discourse. A good case probably can be made for postulating beneficial language-mediated effects of usage instruction on the course of concept learning. The interesting question How beneficial? appears little asked. The answer probably is that some minimal level of benefit can be obtained under laissez-faire conditions, but that optimization of beneficial language mediation effects on children during the early primary years will require instructional design efforts not predicated on the current view that God or the nervous system contributes these effects (or, almost equally as unproductive, that the speech community does so).

A LEARNING HIERARCHY EXEMPLAR

The reader whose time is at a premimum can afford to skip this section, which deals preliminarily with the form that a learning hierarchy reflecting the learning of a simpler concept might take. The view to be presented is that of a learning hierarchy for generalizing linguistic usages nested in a learning hierarchy for generalizing from nonlinguistic exemplars of the concept. A falsifiable assumption of the structure to be presented is that the usage component of instruction will, in consequence of language mediation effects insured by such instruction, make its own contribution to terminal skill.

Inputs and performances for the usage component are as follows:

UP Prerequisite lexical and syntactic skills (previously specified).

UE Usage exemplars presented during training.

UV Verbal characterization of usage exemplars in the context UE.

UR An 0th-order generalization response. The child recalls or selects from a suitable array of positive and negative instances the set of sentences (UE) that training reveals to characterize the usage of the concept. (Either all sentences delete the concept name or all use it, even the negative instances.)

UR' Based on the guided inductive framework provided by UE and UV (and perhaps the deductive possibilities provided by UP), the child constructs or selects from a suitable array other sentences that exemplarize usage of the concept.

UR tests for associative learning; UR', for the sort of concept learning that is of interest. While it is assumed here that UR' will be defective if UR is at less than criterion level, this need not be true and is, of course, a falsifiable assertion.

Inputs and performances for the physical exemplarization component are as follows:

UR' A prerequistie skill, defined above.

CP Other prerequisite skills (to be specified).

CE2 2D concept exemplars presented during training.

CE3 3D (or 4D) analogues to 2D exemplars, presented during training where appropriate. (If CE3 items are appropriate--that is, if the concept is to be understood in the 3D and 4D situation--then criterion specifications will reference to 3D or 4D.)[7]

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7 All sorts of research may be envisioned under the tug of the question: Does 2D training mediate effects in 3D and 4D situations? The schools seem to assume a good deal of 2D-mediated concept learning referencing o 3D and 4D situations.

CV Verbal characterization of concept exemplars in the context CE.

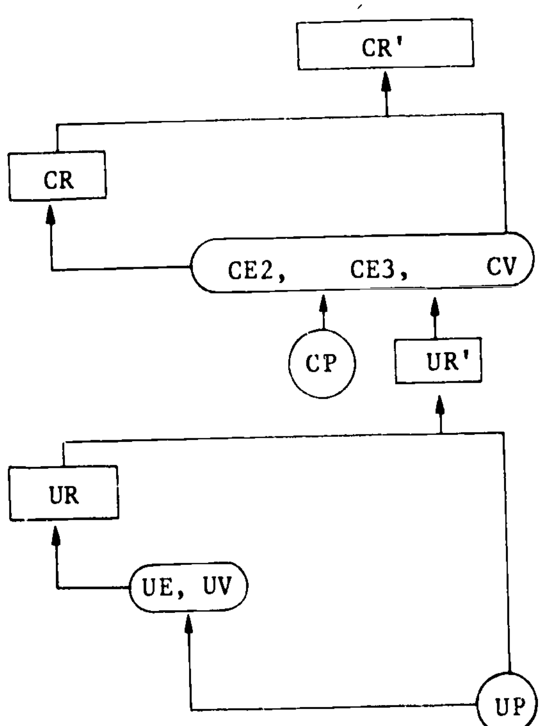
CR An 0th-order generalization response. The child recalls or selects from a suitable array of positive and negative instances the set of exemplars (CE) that training reveals to characterize the concept.

CR' Based on the guided inductive framework provided by CE and CV (and perhaps deductive possibilities inherent in linguistic organization imputed to the child), the child constructs or selects from a suitable array other items that exemplarize the concept.

Comments made earlier concerning UR and UR' apply equally to CR and CR'. The structure for a learning hierarchy referencing to a simpler concept and having "guided language mediation" and "guided concept induction" stages is preliminarily sketched in Figure 1. Boxed items are performances; circled items are inputs.

Figure 1.

Hierarchical Representation of the Learning of a Simpler Concept



Perhaps the Figure 1 representation will prove inadequate even when only a single simpler concept is to be learned. Hierarchical representations of interest probably will be an order of magnitude or two mc complex than that portrayed in Figure 1. Such representations will reflect groups of concepts. Some of these concepts will be organized into hierarchical progressions based on a domain-expansion requirement. Language mediation and perhaps 2D mediation treatments will be reflected. Grammar treatments underlying guided language mediation will appear as prerequisite skills The technology for schematizing learning hierarchies no doubt will need to be extended.

CONCLUDING NOTE

The concept learning literature has been all but ignored in foregoing remarks. The assumption is that the literature references (and creates) all sorts of interesting problems, but for the most part it does not reference the concept learning problem facing the schools. This assumption is likely almost but not entirely correct. In consequence, further efforts along lines sketched above probably should flow from a quite discriminating <u>definition and scrutiny</u> of the literature.

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